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ABSTRACT

A study examined instructional videoconferencing to determine the effects of manipulating the perceived proxemic distance between students and an on-screen instructor on students' recall and attitude response ratings. Subjects, 43 undergraduate students from a multi-section introductory public speaking course at a large midwestern university, were subjected to essentially the same videoconference experience, except that 22 were exposed to a shot content of 51.85% of the screen height taken up by the instructor's head height (the near group), and the other 21 exposed to a shot content of 14.81% of the screen height taken up by the instructor's head height (the far group). Subjects responded to a 10-item fill-in-the-blank instrument after the videoconference. Results indicated that the near group scored significantly higher than the far group. Findings suggest that a videoconferencing environment designed to create the impression of social distance may enhance the ability to recall information and positively affect attitudes concerning the videoconferencing experience; and that designers of mediated learning environments should consider the nonverbal communication construct of perceived proximal distance early in the design phase of course development. (One table and one figure of data are included.) (RS)

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Perceived Proxemic Distance and Instructional Videoconferencing: Impact on Student Performance and Attitude

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Perceived Proxemic Distance and Instructional Videoconferencing: Impact on Student Performance and Attitude

Abstract

Instructional videoconferencing was examined to determine the effects of manipulating the perceived proxemic distance between students and an on-screen instructor on students' recall and attitude response ratings. Results indicated that a videoconferencing environment designed to create the impression of social distance (Hall, 1966) may enhance ability to recall information and positively affects attitudes concerning the videoconferencing experience. Designers of mediated learning environments are recommended to consider the nonverbal communication construct of perceived proxemic distance early in the design phase of course development.

A Nonverbal Communication Consideration for Instructional Videoconferencing Design: Impact of Varying Perceived Proxemic Distance on Student Recall and Attitude Responses

The use of technology-mediated, long-distance educational practices has increased dramatically over the past decade (Arger & Jones, 1990; Purdy, 1986). One delivery mechanism incorporated in long-distance education is known as instructional videoconferencing--using two-way audio and video to link instructors with students separated by significant distances, time conflicts, or other barriers. Presently, several factors provide evidence for a more rigorous research foundation in instructional videoconferencing. These factors are 1) increased likelihood of institutions of higher education gradually escalating the number of distance-education efforts (Dede, 1990; Spigler, 1991), 2) the relative expense of these programs (McCain & Acker, 1990), and 3) the general lack of original research that deals explicitly with the intrinsic and extrinsic factors related to interactive media (Acker and Levitt, 1990).

Typically, instructional designers utilizing the videoconferencing medium have borrowed techniques from traditional broadcasting. As a response to this thinking, Acker and McCain (1990) state that "electronic meetings are handicapped if approached from a broadcasting perspective" (p.8). The usual practice of transmitting a message unidirectionally to an indeterminate audience disregards interaction required by many students (Darkenwald and Merriam, 1982). In addition, certain broadcasting production standards may not be necessary with an environment that requires a different media aesthetic (Zettl, 1990), and education may be an area where such a different aesthetic may apply (Acker & Levitt, 1987).

Constructs worthy of more concentrated consideration for interactive media design include items such as staging, shot selection, turn-taking, lighting, camera-monitor-subject relationships, time utilization, and audio management (Acker &

McCain, 1990). All of these factors are critical to the overall success of the videoconferencing experience. However, cost is a powerful determinant in the utilization of distance learning technologies (Dede, 1990). This practical consideration limits what can be affordably adapted. Additionally, some elements of the videoconference experience may be outside of the control of the designer. Consequently, of the seven previously named factors, only two allow for relatively simple and cost-free manipulations that may significantly alter the overall perception of the videoconference and incur no additional expense.

Time utilization is quite dependent upon the material being discussed and the type of respondents involved in the videoconference and becomes difficult to manage from a design perspective. Lighting creates specific moods and appearances that limit the amount of variation permitted in a nondramatic performance (Zettl, 1990). Audio management that could more closely approximate a face-to-face interaction by allowing directional determination, simultaneous scrutiny of several respondents and subtle discrimination of tone and pitch might provide a more acceptable videoconferencing environment, but can become prohibitively expensive. Staging is an area deserving of more careful study, but may also incur substantial cost related to background design. Thus, out of these potentially manipulable constructs, the elements of shot selection and camera-monitor-subject relationships seem to be the most easily varied and flexible since these involve simple manipulations of equipment that must already be present to accommodate a videoconferencing experience.

Shot selection and camera-monitor-subject relationships when operationalized in a videoconferenced setting yield a construct known as perceived proxemic distance (PPD). PPD refers to how the human brain interprets physical nearness when viewing a facsimile of an individual. Bretz (1983) has suggested that PPD is an important consideration in the design of videoconferencing environments, but no research has

been conducted to determine what effect varying the PPD will have on a particular population.

Thus, in this study, the PPD within an instructional videoconference was examined to determine if manipulating the PPD affected student recall performance of information as measured by an objective testing instrument. In addition, a self-report attitude questionnaire was administered in order to determine if the manipulation of the PPD would alter opinions of the experience. The form of videoconferencing examined in this study is the two-way audio and full-motion video system that attempts to utilize interactive exchange during a real-time setting.

According to Dede (1990), more schools are attempting to incorporate distance-learning techniques such as instructional videoconferencing to do two things. First, many students within the United States, the Phillipines, Indonesia, New Zealand and other geographic locales are separated by a variety of barriers from the experts who are qualified to provide the type of instruction necessary. In order to give students access to the needed educators, schools cover a large distance by transmitting a single instructor's facsimile to students via an assortment of distance-education media technologies (Johari & Shaw, 1986; Benson & Hirschen, 1987; Mody, 1987). This allows students that cannot leave a specific region because of family, jobs, or other barriers to education to receive the kind of classroom experience they need or desire. Second, institutions are only beginning to attempt to market these technological advances and their corollary benefits in order to draw new students to the educational arena. Dede (1990) predicts an eventual implementation of technology-mediated interactive learning for certain topics as the primary choice of delivery and not simply as a means to overcome otherwise insurmountable problems. Although Heller (1989) points out that the avenue of videoconferencing has not penetrated as quickly as originally anticipated by the early adopters of the technology, a significant potential for

future implementation as an applied medium by academic institutions remains.

Telecourses (educational programs delivered through a television medium) and, specifically, instructional videoconferences offer an alternative to traditional education that bridges some of the distance problems. However, this process is fraught with numerous caveats that must be observed by the instructional design team. Regrettably, designers of these systems often are ignorant of the fundamental constructs and types of applications that may dictate final usages (Acker & McCain, 1990).

Bretz (1983) states that there are two general goals to be pursued by those who design teleconferencing systems: "(1) to simulate, within the limitations of the medium, the experience of face-to-face communication, and (2) to go beyond the possibilities of face-to-face meetings and develop new kinds or dimensions of communication" (p. 174). Telecourses delivered through the mechanism of videoconferencing introduces a third objective: successful education.

Designers of an interactive telecourse must be concerned with how these objectives can be operationalized. Acker and McCain (1990) suggest that one approach to making the videoconferencing experience work more efficiently and successfully is in the manipulation of certain intrinsic elements present in the videoconferencing environment. Bretz (1983) names the nonverbal communication construct of PPD as one of these elements to consider when facilitating interactive videoconferencing.

Although nonverbal communication constructs have not been examined within a technology mediated context, numerous studies have been conducted in primary, secondary, and post-secondary traditional learning settings concerning the impact of environmental design on student performance and response (Gump, 1985; Vosko & Hiemstra, 1988). One aspect of environmental design has been the relationship between student and instructor that is facilitated or hindered by certain physical features

of that environment.

Griffith in 1921 offered the first observation of grades varying according to seat location. Rear row students averaged poorer grades; however, the front rows did not emerge as the highest scorers in the large lecture courses, it was the third and fourth row students who achieved the highest grades. Adams and Biddle (1970) suggested the term action zone to describe this physical region of the classroom where students were expected to interact more with the instructor than students seated outside of this area. Stires (1980) and Levine, O'Neal, and McDonald (1980) confirmed in their studies that students seated within this action zone not only interacted more frequently, but performed better (scored higher marks) than those seated outside the zone, even in situations where seating had been assigned. Although a small number of studies have shown no real significant effect of the action-zone hypothesis (e.g., Wulf, 1977), there seems to be enough general support for the action zone construct to be an important consideration in classroom design.

Possibly an explanation for this grade phenomenon is what has been termed teacher immediacy. Immediacy is a construct that implies that interactants are accessible to one another through verbal, paralinguistic, visual, and/or physical means. Gorham (1988) isolated verbal immediacy and found when teachers responded to students with some type of verbal and/or paralinguistic cue immediately following a question or comment, the arousal level of the students generally increased. This increased arousal level yielded more positive attitude ratings concerning a variety of issues relevant to the classroom setting. Although no link between arousal level and student performance on testing instruments has been solidly established, many instructors consider students' positive attitude ratings of the course to be a desirable outcome of the education process. Presumably, positive attitudes would have an impact on factors such as continued enrollment, motivation, and other less tangible

constructs related to education.

Kearney, Plax, and Wendt-Wasco (1985) and Kearney, Plax, Smith, and Sorensen (1988) point to similar concerns about the environment established in the classroom when they discuss the notion of teacher immediacy. The authors of these studies suggested that those teachers who appear to be immediate tend to have students that are more motivated to cooperate with the instructor as indicated by a variety of student self-report instruments. These authors stated that "nonimmediate teachers may be perceived as communicating sarcasm or ridicule" when attempting to use prosocial strategies to gain student compliance. Thus, both arousal level and compliance have been positively linked with immediacy.

In the full two-way audio and video environment, immediacy displayed through verbal and paralinguistic means is available to the interactants. Whether or not this strategy is employed becomes more dependent on the interactants than on the technology. The same is true to a lesser degree with visual immediacy cues such as facial expressions, gestures and eye contact. The video image received by the interactants may be limited due to monitor size, reception clarity, and the like, but the television image is able to represent very subtle variations in facial expression and eye movement.

Acker & Levitt (1987) addressed two key points relevant to eye contact and videoconferencing. Creating the illusion that participants from all points of a videoconference can establish and maintain direct eye contact is technically achievable. More important, Acker and Levitt state that the perceived success of a videoconferenced exchange within the United States may hinge on the videoconferencing team's ability to realize this illusion. Incorporation of the Acker and Levitt system results in the perception that direct eye contact is maintained from all vantage points of the viewing area. Sometimes referred to as the "Mona Lisa" effect

(Zettl, 1984), this phenomenon could provide the means to demand greater attention from students who otherwise might fall outside of the action zone in a traditional-classroom setting since more of the students would be perceiving the eye contact as direct to them. Because of this visually induced immediacy, the increased potential for students to maintain eye contact can be proffered as a potential advantage of the videoconferenced environment.

However, one aspect of immediacy that may be more difficult to replicate in a videoconferenced setting relates to the physical accessibility of the interactants. Certainly, haptic sensations are eliminated as nonverbal interactive immediacy cues. But the notion of physical immediacy being determined by relative distancing of the interactants was initiated by Hall (1966) and may play a role in a videoconferenced interaction as suggested by Bretz (1983).

Hall's taxonomy of interactant distancing (proxemics) has been referenced widely and can be applied to traditional classroom settings as well as to dyadic situations. The four categories used to identify the separate proxemic regions are intimate, personal, social, and public, all of which can be broken down into a near and far phase. Intimate and personal distances typically are not present within the types of classes that are taught in formal academic institutions. Lecture/discussion classes usually are of a comparatively small size with discussions outside of the personal realm; they frequently are structured at a near or far social distance. Given the proliferation of large lecture courses with several hundred participants, classroom environments of the public-distance type are not uncommon. Consequently, a variety of proxemic distances are found in traditional classroom environments.

Bretz (1983) computed a range of PPD's for television viewing equitable with the live interactions described by Hall's (1966) taxonomy. By measuring specific viewing distances, screen sizes, shot content (camera focal length with respect to

subject to camera distance) and distances from the viewing screen, Bretz was able to develop a scale that was based on the final net image produced on the retina. By incorporating Bretz's computations, comparisons of various PPD's within an instructional videoconferencing environment can be made.

The previously cited literature suggests that the action zone is a viable consideration for classroom environmental design. This construct can explained through various verbal, nonverbal, paralinguistic and physical elements of immediacy displayed by the instructor to the students. Since the videoconferenced environment replicates these immediacy cues with relative accuracy with the exception of the physical dimensions the following question can be asked. Within an instructional videoconference, would an action zone appear in a student population based on a perceived proxemic distances?

Hypotheses

In this study, the effect of varying PPD on student-recall performance and attitude response was examined. The literature previously discussed would predict that the farther away an instructor appeared on a television screen, the less immediate that individual would appear to the student viewing the monitor. Previous research also would suggest that if a teacher is less immediate, students may perform at a lower level and would report less positive attitude responses concerning the course and the instructor. Thus, the hypotheses put forth in this study were:

H1: The recall performance of students within an instructional videoconference who perceive the proxemic distance distance between themselves and the instructor to be relatively near may be better than students who perceive the proxemic distance to be relatively far.

H2: Students who perceive the proxemic distance to be relatively near may report more positive attitudes for the course and instructor than

those students who perceive the proxemic distance to be relatively far.

Method

Forty-three undergraduate students from a multi-section introductory public speaking course at a large midwestern university served as the subject group for this study. Of these, 22 were in a near group (A), and 21 were in a far group (B). Both groups were subjected to essentially the same experience, with the only difference being the manipulation of the PPD variable by altering the focal length of the camera lens transmitting the visual content of the message.

Since placement of the respondents with respect to the viewing screen was a critical element, seats were arranged into four rows in advance and assigned a number. This numbering was keyed to a measurement taken before the students were admitted into the viewing room. Once seated, students were not permitted to move the chairs from the designated location. This physical arrangement yielded distances of 9, 11 1/2, 14, and 16 feet from the viewing screen.

The near group was exposed to a shot content of 51.85% of the screen height taken up by the instructor's head height. The far group was exposed to a shot content of 14.81% of the screen height taken up by the instructor's head height. Both of these ratios were derived from simple measurements taken of the projected head and of the screen height. The resulting PPD's using the Bretz adaptation of the Hall scale for group A was one row on the border between personal distance and near social distance (n=4), one row in the middle of the near social distance range (n=6), one row on the border between near social and far social distance (n=8), and one row in the far distance range (n=4). Group B resulted in two rows within the middle of the near public distance range (n=10), one row on the border between near public and far public (n=5), and one row in the far public distance range (n=3). These distances were incorporated to ensure that those distances found in traditional classroom

environments would be replicated in the videoconferenced environment for purposes of comparison.

Prior to the experimental sessions, respondents were informed that a quiz would follow the lecture/discussion and that the score received on this quiz would be figured into their overall grade for the course they were taking for credit. This was done to ensure that a realistic incentive for performance had been engaged. However, all respondents were allowed to leave the experimental setting at any time. The grades were not used in the actual computation of the course scores. All subjects were debriefed as to the genuine nature of the task the class period following the experiment. With these criteria in place, the process fell within the guidelines of the Human Subjects committee. None of the participants reported suspecting being involved in an experiment.

The subjects were instructed to put all books, papers, notebooks, coats, and other such items away, not attempt to take any notes, and pay particular attention to the presentation. Notes were not permitted due to the variety of note-taking styles and the varying ability of students to synthesize information on paper. Since note-taking ability was not being measured, it was intentionally left out of the process so as to eliminate a potentially confounding variable.

The respondents were given a verbal introduction to the videoconferencing experience that reported the instructor was from a distant university and was a considered authority in the field. They were encouraged to participate in the discussion when opportunities were presented since the instructor could communicate with them in real time. Although the material was tangentially relevant to discussions held in the course in which they were enrolled, none of the students reported being exposed to the specific information incorporated in the experiment within the context of their current course or any other communication course.

Once the introduction was completed and all adhered to the instructions, the monitor was turned on and the special instructor was presented to the class. The instructor, a knowing confederate in this study, provided an outline of the material being presented to the administrator of the experiment and rehearsed the presentation to fit into an eleven-minute window. Although the instructor's image was transmitted from a location within the same building, none of the subjects reported recognizing the individual during the videoconference when they were informed of the real nature of the experience. The instructor in the experiment experienced some minor deviations between the lessons, mostly as a result of differing responses from the subjects in the interactive process. However, the major testing items were covered with equal weight with respect to time. Other nonverbal elements, such as amount of sustained eye contact, vocalics, and other paralinguistic cues, were judged to be acceptably consistent between presentations by the administrator of the experiment. This evaluation was based on the amount of time devoted to each element as recorded on a videotape of the actual transmissions.

Immediately following the presentations, the testing instrument was distributed to the respondents. This instrument contained ten objective, fill-in-the-blank questions. The ten objective questions were written in collaboration with the confederate instructor to help ensure consistency between what was being presented in the lecture/discussion and the testing instrument. A panel of six independent judges looked at the testing instrument with respect to the material covered in the presentation and determined that the questions were internally valid.

This examination format was selected over other objective forms because the possibility of getting the answers correct by chance alone was presumed to be at the smallest possible level. Other forms of testing such as matching, multiple choice, and even essay questions, conceivably contain a certain degree of chance and previous

knowledge bias; thus, this instrument was an attempt to eliminate error through a set of supply-the-term questions. Participants recorded their names and their seat numbers on the testing instrument. Once the participants completed the objective exam, they were asked to complete an attitude survey sheet containing eight questions using a Lickert-type scale and one open-ended question.

Results

Group A, the near group, scored significantly higher on the objective test than did group B. Overall, group A scored significantly higher with an average of 62.23% correct, as opposed to group B, whose members scored an average of 46.63%. A comparison of mean scores yielded an even more disparate range between the near group and far group, with means of 65% and 46%, respectively ($t = 2.34$, $p < 0.05$). A moderate effect size because of the small sample was noted at 9.6% of the variance.

The objective-test scores can also be plotted by rows to help project exactly where an optimum viewing range may exist. As noted earlier, the sample sizes of the rows are quite small. The average of the test scores by rows, though not as powerful as the overall group scores, suggests a most intriguing pattern, as shown in Table 1.

Insert Table 1 about here

When the test scores are mapped with respect to distance, a curve with a very specific apex of effect is noticed in Figure 1.

Insert Figure 1 about here

The instrument measuring attitudes was internally reliable for all items

(α=0.77). The attitude questionnaire responses were factor analyzed utilizing a VARIMAX rotation. The criteria for a factor were an eigenvalue of 1 or greater, two items per factor, and primary loadings of at least 0.45 with no secondary loadings above a 0.20 difference. Two factors met these criteria. However, discontinuity in eigenvalues of the two factors (3.07 versus 1.13) suggests that the responses are unidimensional. Further analyses using oblique and standard rotated matrices yielded similar eigenvalues. This, the interpretation was that no underlying dimensions were present in the item responses.

All measures of attitudes utilized a Lickert-type scale where nine equals strongly agree and one equals strongly disagree. Items were averaged to obtain the one to nine response score. Of the eight items, three displayed statistically significant differences. When asked if the videoconference should be a more extended portion of the overall course, the near group displayed a stronger positive response to the course than did the far group (6.14 versus 5.14; $t = 1.83$, $p < 0.05$). The instructor's liking rating was higher for the near group than for the far (7.95 versus 6.9; $t = 2.67$, $p < 0.05$). Finally, when asked if they would enroll in a course that utilized videoconferencing as the main medium of instruction, the near group responded with a more positive response (4.73 versus 3.48; $t = 2.70$, $p = 0.05$). Indeed, four students in the far group answered with a number 1 on their evaluation form, whereas no individual in the near group was quite as polarized in her or his view.

The open-ended responses displayed generally negative views and opinions from both groups. Statements such as "...Big Brother was watching me!" and "The experience was very impersonal, it took the humanity out of learning," were written by the near group respondents. Quite a number of students wrote such statements as, "The technology was a shock," "I paid more attention to the TV than to the topic," and

"More awareness of what were going to see would help."

Discussion

The distance curve obtained when test scores were mapped with respect to virtual distance measures reflects the action-zone construct previously described. These scores suggest that, even in a videoconferenced environment, certain ranges of distance help students attend to information. This is true even though those distances are created by the student's perception of distance and not an actual physical presence.

How this zone differs from the action zone described in more traditional classroom settings could be in the basic shape of the zone. In a traditional classroom setting the action zone has typically been mapped as the upper central circle that corresponds to the area where the instructor can establish eye contact with the students readily. The test scores of the various rows suggest an action zone with fall-off areas nearer or farther away from the instructor than the ideal, but no real difference is noted laterally--an area consistent with the "Mona Lisa" effect. Since participants in a videoconferencing environment can seemingly maintain eye contact from a wide range of angles, a longer line of participants arranged in a shallower depth would seem preferred. This arrangement is corroborated by design suggestions maintained by Bretz (1983) and Acker and Levitt (1987) with respect to videoconferencing environments.

The attitude responses are evidence of the impact of PPD on less measurable educational concerns such as how students would view an instructor, how inclined they would be to enroll in courses, and how much they would enjoy using certain technologies in the classroom. The results confirm immediacy effects noted in traditional classroom settings with respect to self-report of attitudes about the course and the instructor.

A concern that was noted as a result of the open-ended responses out of the

higher scoring students on the the attitude survey form suggested a very negative--almost technophobic--reaction to the medium. This presents a certain contradiction: some students still could attend to the information but were compelled to object to the manner in which that information was transmitted to the class. This initial repulsion might be attributable to the generally nontechnical orientation of the students' majors within the subject groups. Most students who participated in this study were enrolled in liberal arts curricula. Another possible explanation for the negative reaction is that the subjects viewed the technology as dehumanizing in some form. These reactions would seem to contradict notions that videoconferencing is a possible replacement for traditional instructional modalities (Dede, 1990; Heller, 1989). These responses could dissipate in time as students became familiar with the technology; however, further exploration as to the reasons for this generally negative response seems necessary.

Several concerns surface when discussing this study. One potential problem is the relatively small sizes of the subject groups. Although the results of the study clearly indicate significant differences between these two groups, more subjects and more types of students could be utilized in this environment to incorporate better randomization as a factor to control for error. Another potential problem could be confounding differences in student response based on personal technical orientations. In addition, the exclusion of personal-learning habits from the process, such as the taking of notes, removes another differentiation in the educative process that is generally present in real-world learning environments.

The results of this study indicate that important differences in recall performance and attitude responses can be associated with the perceived proxemic distance between the student and the instructor. Physical immediacy of the instructor, thought to be an important element in the design of traditional educational environments, can be extended as an applicable principle even within a technology-

mediated instructional experience. Social distance apparently can be emulated in an instructional videoconference.

PPD emerges as a critical construct for telecourse designers to consider in the early stages of course development. Shot content, size of viewing screen, distance between screen and viewing audience, and physical arrangement of participants within the videoconferencing environment function as key elements to manipulate in order to control PPD. Consequently, design of viewing environments, story boards, graphics incorporation, and other technical options should be developed under these core mechanical requirements of preferred PPD creation.

Although more study dealing with instructional videoconferencing is necessary, this study provides evidence that constructs often ignored at the design stage may carry much influence over final results of a telecourse. Problems with courses that are attributed many times to poor teacher abilities or poor students more accurately may be a reflection of poor thought on the part of the designers of the instructional environment.

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Table 1

Group Row Distances, Virtual Distances, PPD's, and Test Scores

Row	Actual Distance	Virtual Distance*	PPD	Scores
1-A	9'	4'	Personal/Near Social	55%
2-A	11.5'	5.5'	Near Social	61.7%
3-A	14'	7'	Near/Far Social	72.5%
4-A	16'	8.5'	Far Social	62.2%
1-B	9'	14'	Near Public	56.3%
2-B	11.5'	20'	Near Public	46%
3-B	14'	25'	Near/Far Public	47.5%
4-B	16'	30'	Far Public	43.3%

*virtual distance equals measure of interaction if it were face to face

Figure 1

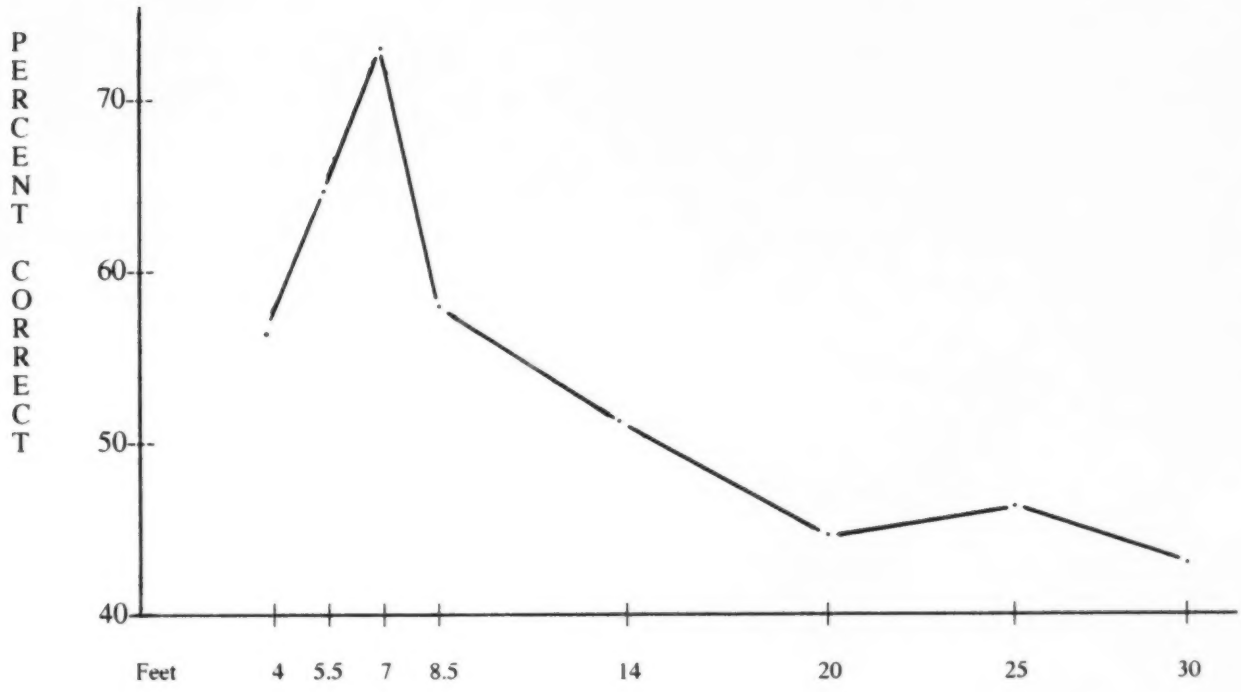

Figure Caption

Figure 1. Objective test scores plotted in conjunction with row virtual distances.